User's Manual

Audiometer

Earscan ES-TRAM

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Revision B

The names of any providers and patients used in illustrations or examples in this document are fictitious.

Every effort has been made to ensure this manual is accurate, complete, and useful. Please let us know if you have any suggestions for improvement using one of the following means of contact:

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Preface

About this Document

This document is part of the set of user manuals provided with the AFHCAN Cart. These user manuals, covering various topics, are normally assembled into a binder delivered with each Cart. This modular design has the following advantages:

- the set of manuals provided with your cart includes documents for the specific peripheral devices installed
- each document is a stand-alone publication, so as new devices or features are added to the Cart, new manuals can be added to the existing binder
- user information that is common to all items of equipment does not need to be repeated in each module, but can be covered in separate modules and referenced as needed

One Device, Two Functions, and Two Sections

The Earscan ES-TRAM includes tympanometry and audiometry functions in the same unit. Because these functions are handled by separate areas in the AFHCAN software, the two functions are covered in their own sections of this binder. Refer to the Tympanometry Section for information on tympanometry.

Related Documents

This document assumes you have read the introductory hardware and software manuals included in this binder.

The original manuals provided with the equipment were included in a set of materials delivered with the AFHCAN Cart. Those manuals can be used to supplement the information provided in this document. Be aware, however, that items installed on an AFHCAN Cart may have been modified slightly, so the features as described in the original product manuals may not apply.

For More Information

This document describes the equipment to a level of detail that will meet most user's needs in the context of clinical use of the AFHCAN Cart. For more information, contact AFHCAN Customer Support:

AFHCAN Customer Support
Phone: 888 449-4435
Fax: 907 729-2269
email: customersupport@afhcan.org

Additional information can be found on the manufacturer's web page:

www.microaud.com

Section 1 – Introduction

1.1 Becoming Familiar with the Audiometer

This manual describes the principal features and operation of the Micro Audiometrics Earscan Audiometer, as installed on an AFHCAN Cart.

1.1.1 Functional Description

1.1.1.1 Normal Operation

The audiometer automatically performs a hearing test to measure hearing thresholds at several frequencies. The right ear is tested first, then the left ear. Results are presented in a graph that shows lowest level of sound energy that the patient could detect at the various frequencies presented. The test takes about ten minutes.

The audiometer brackets the sound level at each frequency based on patient responses, stepping down in volume when the patient responds to a tone, and then up in volume until a response is obtained. This allows the system to quickly determine the minimum detectable sound level. The range of testing volume is from a minimum of 0 decibels to a maximum of 90 decibels. Hearing is tested in the following sequence of frequencies (in cycles per second or *Hertz*):

1000 Hz 500 Hz 1000 Hz 2000 Hz 3000 Hz 4000 Hz 6000 Hz 8000 Hz 250 Hz

During the test, the LCD display on the Earscan module will display information on frequency, volume, tone activation, and user response. On completion of the test, the Earscan module will generate a musical sound audible to the operator, and the data will be displayed on the ***Audiometer*** screen (on the cart). Because the LCD display indicates when tones are presented, it is important for the patient to face away from the audiometer. The individual performing the test need not monitor the LCD display either, because audible cues will be provided for the end of test or for any errors that may occur.

1.1.1.2 Automatic Error Detection

The system automatically detects the following different types of response errors:

- holding the response button down
- guessing
- inconsistent responses

With each type of error, the audiometer will generate an audible signal, and the ***Audiometer*** screen will provide instructions on how to instruct the patient and respond to the error. The test can either be resumed from where the error was detected, or it can be restarted from the beginning.

1.1.2 Main Components

The Earscan audiometer consists of the following components (Figures 1 through 4):

- Earscan electronics module
  - power cord
  - serial data cable
- audiometry headphones
- patient response button

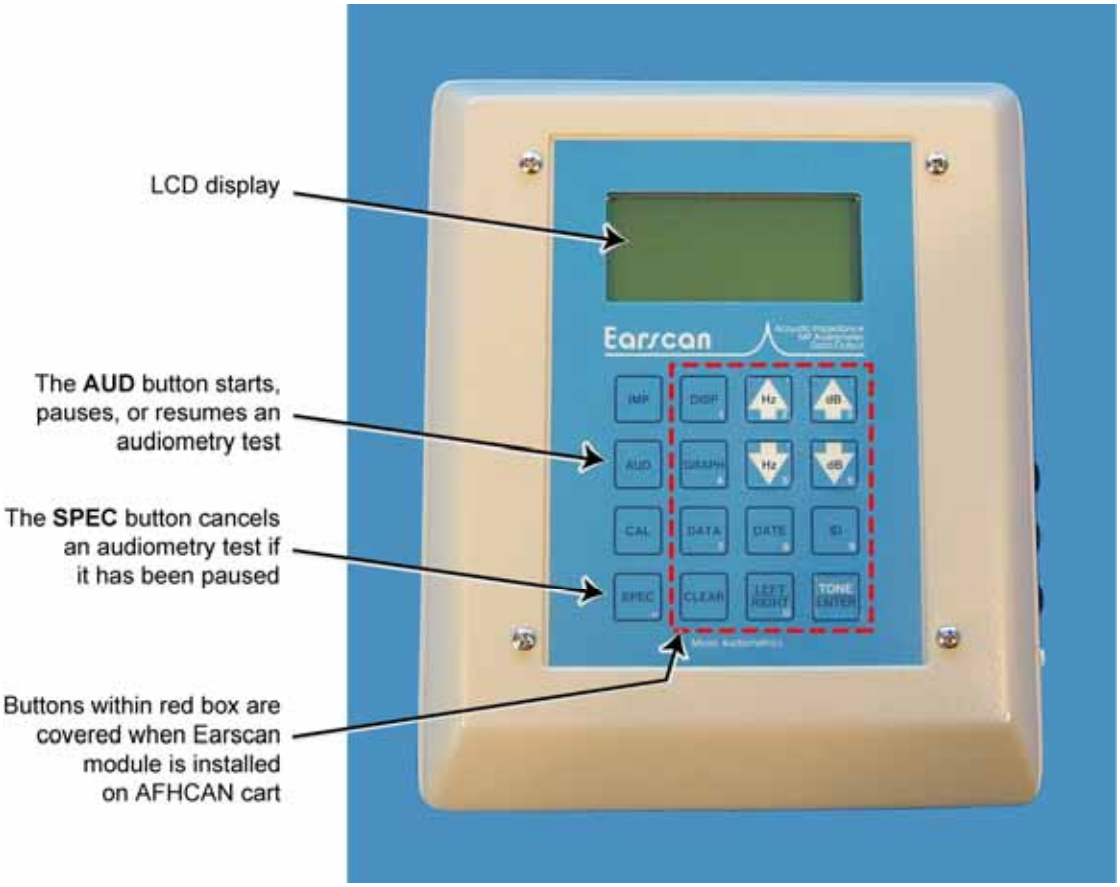

LCD display
The AUD button starts, pauses, or resumes an audiometry test
The SPEC button cancels an audiometry test if it has been paused
Buttons within red box are covered when Earscan module is installed on AFHCAN cart
Earscan

Figure 1
Earscan module - front

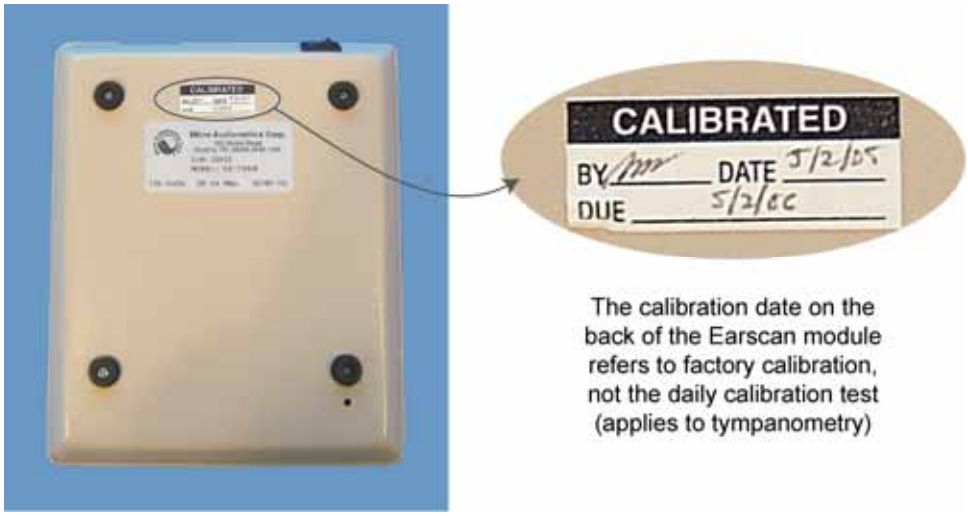

CALIBRATED
BY
DATE 5/2/05
DUE 5/2/06
The calibration date on the back of the Earscan module refers to factory calibration, not the daily calibration test (applies to tympanometry)

Figure 2
Earscan module – back

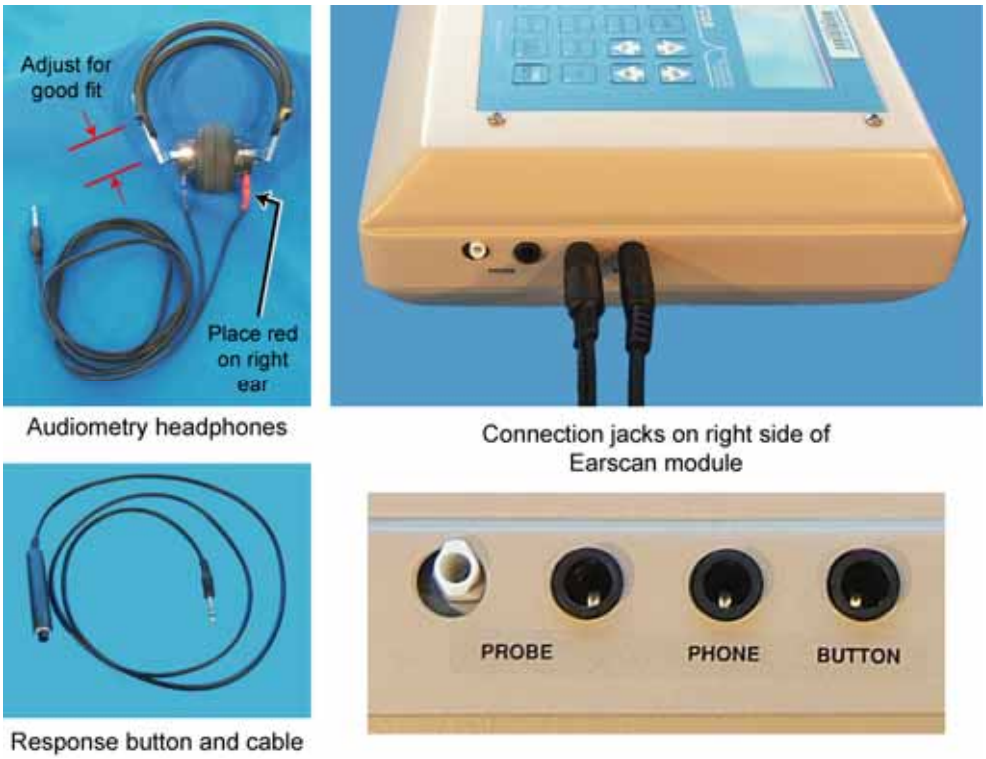


Figure 3
Earscan module – connectors on right side

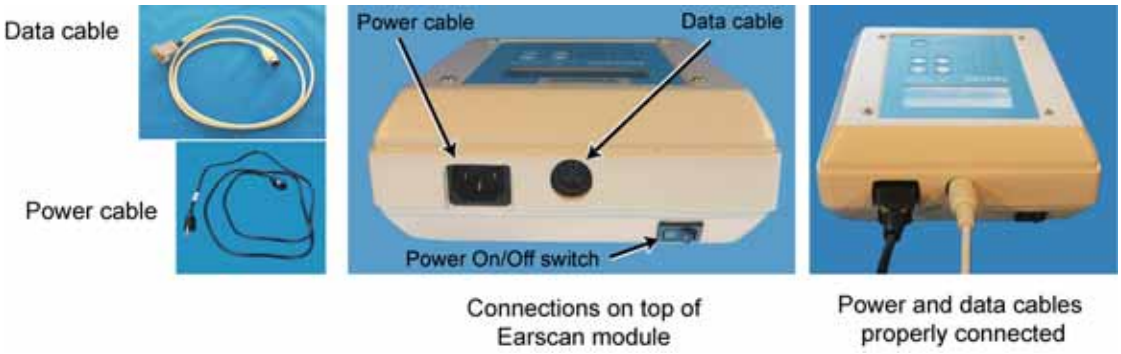


Figure 4
Earscan module – connectors and power switch on top

1.1.3 Hardware Controls and Indicators

The Earscan audiometer includes the following controls and indicators:

- Power On/Off switch – located on the top of the electronics module; used to apply power to the device (may be turned off when device is not in use, see Figure 4 above)
- Pushbutton controls – located on the front of the electronics module; only four buttons are active when the device is installed on an AFHCAN Cart (refer to Table 1 for functional descriptions)
- LCD display panel – located on the front of the electronics module; used to display data as well as the messages generated by the audiometer (refer to Table 2 for examples of messages)

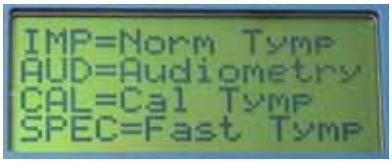
Table 1
Active buttons on Earscan electronics module and their functions

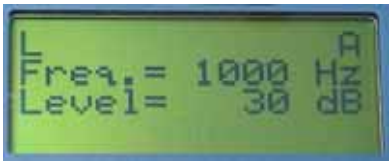
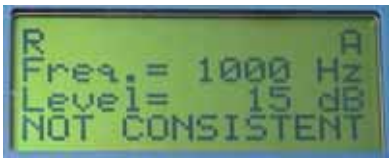
Button	Function
IMP	If the ***Audiometer*** screen is displayed, and the **IMP** button is pressed, a message will be displayed on the Cart saying that tympanometry cannot be done from the ***Audiometer*** screen. A tympanometry test will be initiated by the device, but no tympanometry data will be captured into the case.
AUD	If the ***Audiometer*** screen is displayed, and the **AUD** button is pressed, an audiometry test will begin almost immediately.
CAL	If the ***Audiometer*** screen is displayed, and the **CAL** button is pressed, a message will be displayed on the Cart saying that tympanometry cannot be done from the ***Audiometer*** screen. A calibration test will be initiated by the device, but the calibration data will be captured into the case. Once calibration has been selected, the calibration test must be completed, or the Earscan module must be reset by turning the Power On/Off switch to off, then on.

Button	Function
	If the ***Audiometer*** screen is displayed, pressing the **SPEC** button on the tympanometer can have one of two results: a) if an audiometry test is underway but has been paused (by the user or due to an error), pressing **SPEC** resets the Earscan module. Audiometry can be restarted by pressing the **AUD** button. b) if audiometry has not been started, a message will be displayed on the Cart saying that tympanometry cannot be done from the ***Audiometer*** screen. A fast tympanometry test will be initiated by the device, but no tympanometry data will be captured into the case.

Table 2

Earscan-generated messages

Message on LCD Display	Meaning
	This display appears briefly when the Earscan module is first powered up. Line three shows the EPROM version of the Earscan module's internal software.
	This display may appear if the Earscan module is turned on before the ***Audiometry*** (or ***Tympanometry***) screen has been brought up by the AFHCAN software. Simply bring up the screen by pressing the **Audiometry** button on the ***Add To Case*** screen. When the ***Audiometry*** screen is displayed, press the **AUD** button on the Earscan module, and the device will establish communication.
	This display indicates the Earscan module is ready to begin any one of the four available functions. Press **AUD** to begin audiometry. (Pressing one of the other buttons will begin a tympanometry function, and result in an error message on the ***Audiometry*** screen.)
	This display appears very briefly at the start of an audiometry test. From left to right, and top to bottom, the items shown are as follows: **R** indicates the right ear is being tested; **M** indicates manual testing (which is a default state that changes to automatic almost immediately; **Freq.= 1000 Hz** indicates that a tone of 1000 Hertz will be generated; **Level= 25 dB** indicates the tone will be presented at a volume of 25 decibels; **UNTESTED** indicates no test data has been saved.

Message on LCD Display	Meaning
	This display is typical for most of the audiometry testing. **L** indicates the left ear is being tested. **A** indicates testing is being done in automatic mode.
	In line 1 of this display, ✱ indicates when the patient is holding the response button down. In line 4, **-ON-** indicates when the tone is actually being presented to the patient.
	In line 4, **BUTTON HELD** is an error message indicating that the patient is holding the button down. The Earscan module will generate an error tone, and an error message with instructions will be displayed on the ***Audiometer*** screen.
	In line 4, **FALSE RESPONSE** is an error message indicating that the patient is trying to guess (too many responses falling outside the response window). The Earscan module will generate an error tone, and an error message with instructions will be displayed on the ***Audiometer*** screen.
	In line 4, **NOT CONSISTENT** is an error message indicating that the patient is giving inconsistent responses (detects a tone at a low volume, but does not detect a tone at a louder volume). This situation can be caused by background noise during the test. The Earscan module will generate an error tone, and an error message with instructions will be displayed on the ***Audiometer*** screen.
	This display comes up when an audiometry test is placed in pause mode by the operator. To place the Earscan module in pause mode, press the **AUD** button while an audiometry test is underway. To resume the test from where it left off, press **AUD** again. To cancel the test and reset the Earscan module, press **SPEC**. When any of the error messages above is displayed, the Earscan module goes into pause mode. Pressing **AUD** and **SPEC** resume or cancel the test even though the message at the left is not displayed.
	This display appears briefly, and indicates that the test has been completed and data is being sent to the computer. On completion of the test, the Earscan module will generate a short sequence of tones.

1.1.4 Audiometer Screen

Figure 5 shows the first screen that appears when the **Audiometer** button is pressed on the ***Add To Case*** screen. The screen provides basic instructions at the top, and illustrates which buttons to push on the Earscan module. The on-screen Earscan buttons are not active. Table 3 describes the functions of the buttons on the ***Audiometer*** screen.

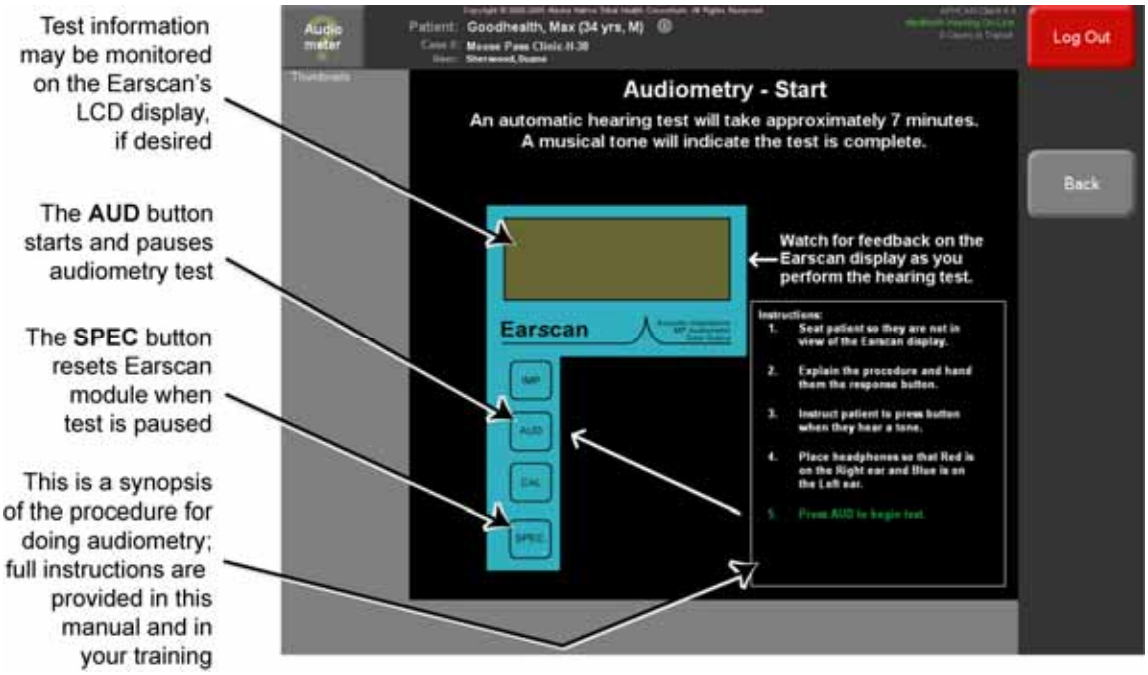

Test information may be monitored on the Earscan's LCD display, if desired
The AUD button starts and pauses audiometry test
The SPEC button resets Earscan module when test is paused
This is a synopsis of the procedure for doing audiometry; full instructions are provided in this manual and in your training
Audiometer
Patient: Goodhealth, Max (34 yrs, M)
Log Out
Audiometry - Start
An automatic hearing test will take approximately 7 minutes.
A musical tone will indicate the test is complete.
Back
Watch for feedback on the Earscan display as you perform the hearing test.
Earscan
Instructions:
1. Seat patient so they are not in view of the Earscan display.
2. Explain the procedure and hand them the response button.
3. Instruct patient to press button when they hear a tone.
4. Place headphones so that Red is on the Right ear and Blue is on the Left ear.
5. Press AUD to begin test.

Figure 5
Initial screen for audiometry

Table 3

Buttons on ***Audiometer*** screen and their functions

Button	Function
Take Another	The **Take Another** button appears when a test has been completed and the data is displayed on the screen (see Figure 7). Pressing the **Take Another** button returns to the initial ***Audiometer*** screen, at which point another test can be done.
Save	The **Save** button appears after data has been saved into a thumbnail. Pressing the **Save** button saves all selected audiometry data obtained in this session to the case and returns to the ***Case*** screen.
Back	Pressing the **Back** button discards all audiometry data obtained in this session and returns to the ***Add To Case*** screen.

Pressing the **AUD** button on the Earscan module will bring up the screen shown in Figure 6. As long as the test is under way, the "run indicator" will be in motion.

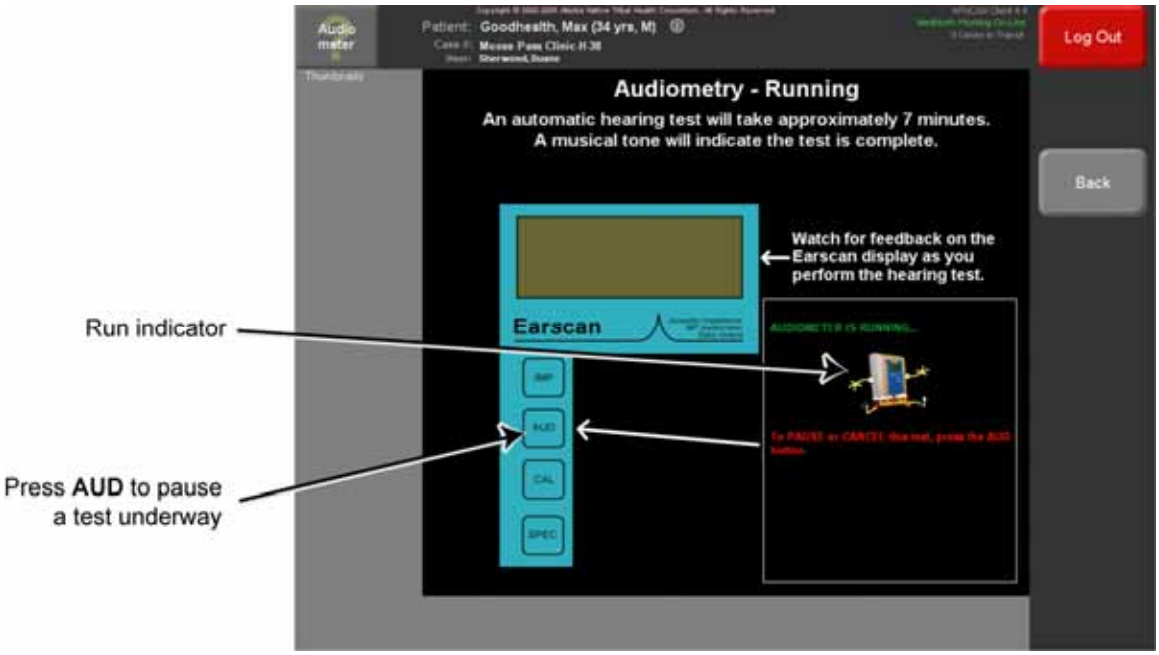

Audiometry - Running
An automatic hearing test will take approximately 7 minutes.
A musical tone will indicate the test is complete.
Watch for feedback on the Earscan display as you perform the hearing test.
Earscan
Log Out
Back
Run indicator
Press AUD to pause a test underway

Figure 6
Screen when audiometry test is underway

On completion of an audiometry test, the Earscan module will alert the operator with an audible signal, and the test results will be displayed, as shown in Figure 7. Numerical results corresponding to the graph are shown at the top, along with information about the date, time, and type of test.

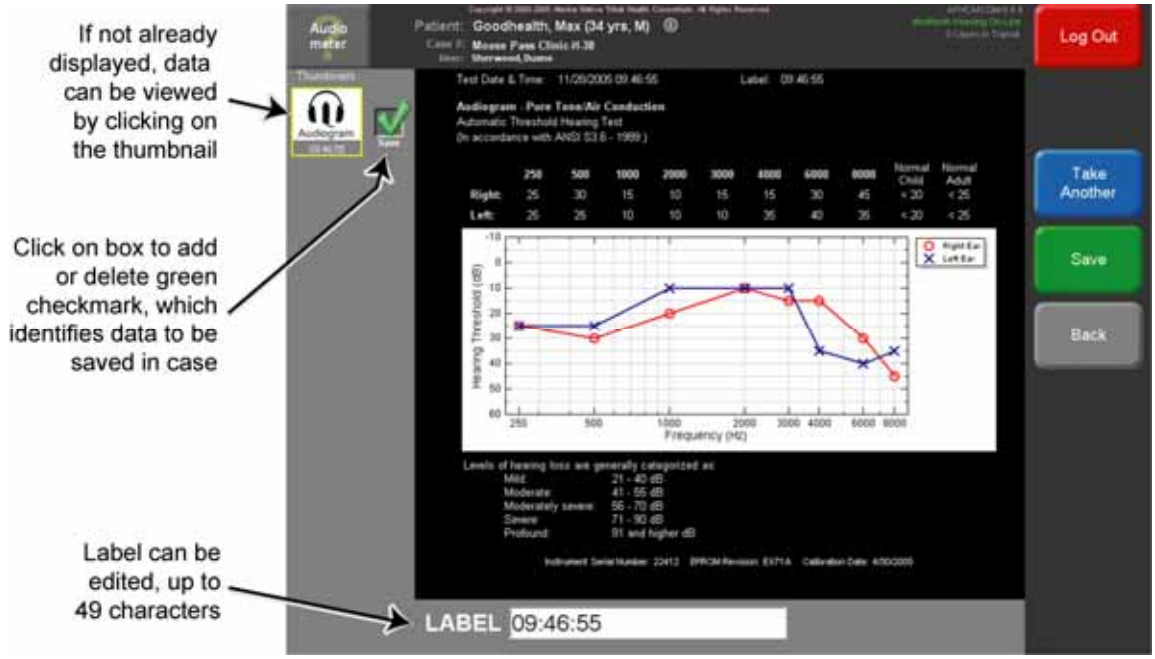

If not already displayed, data can be viewed by clicking on the thumbnail
Click on box to add or delete green checkmark, which identifies data to be saved in case
Label can be edited, up to 49 characters
Log Out
Take Another
Save
Back
LABEL 09:46:55

Figure 7
Audiometry data display

There are four error situations that can arise during a test. Figure 8 shows the screen that appears when the patient holds the response button down too long.

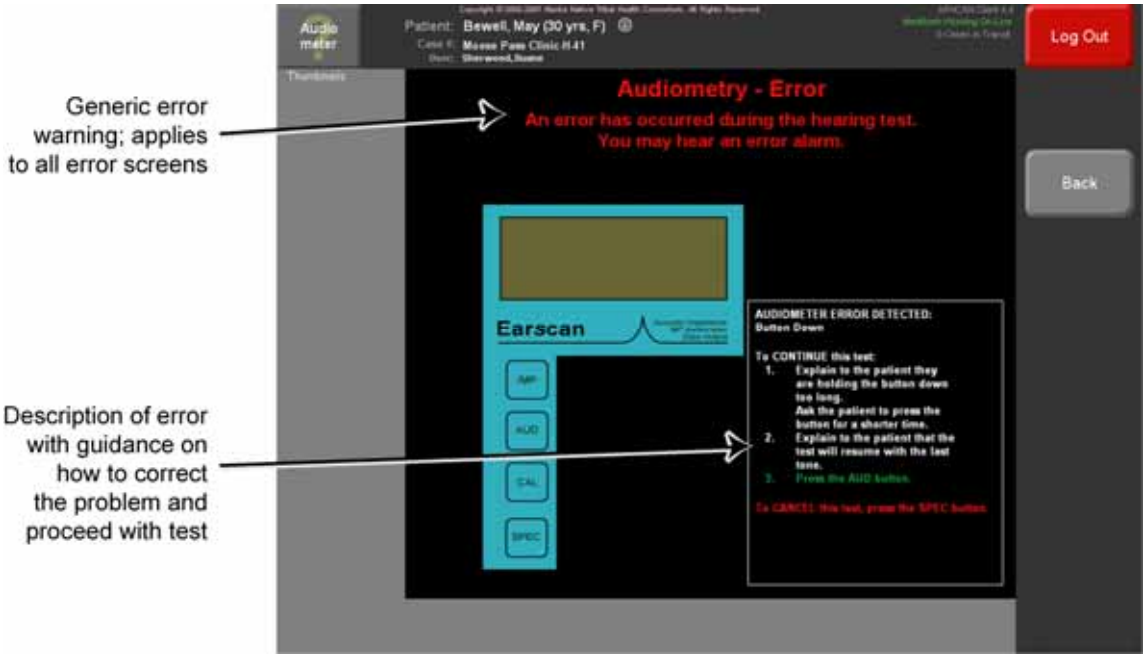
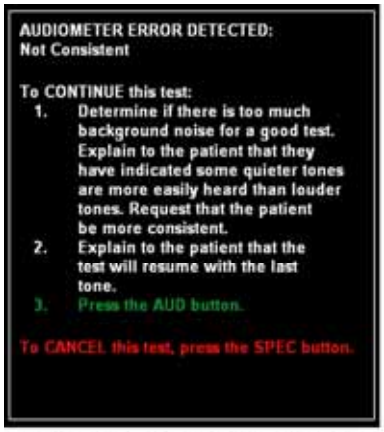
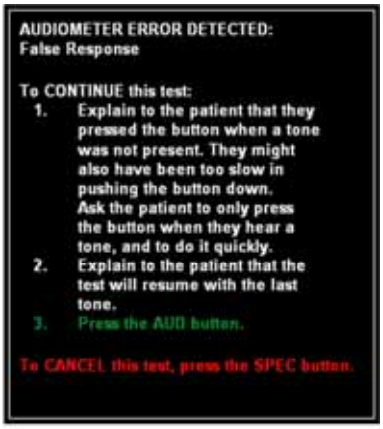

Generic error warning; applies to all error screens
Description of error with guidance on how to correct the problem and proceed with test
Audiometry - Error
An error has occurred during the hearing test.
You may hear an error alarm.
Log Out
Back
Earscan
AUDIOMETER ERROR DETECTED:
Button Down
To CONTINUE this test:
1. Explain to the patient they are holding the button down too long.
Ask the patient to press the button for a shorter time.
2. Explain to the patient that the test will resume with the last tone.
3. Press the AUD button.
To CANCEL this test, press the SPEC button.

Figure 8
Audiometry error messages

The other situations where the error message screen can arise are shown in Figure 9.


AUDIOMETER ERROR DETECTED:
Not Consistent
To CONTINUE this test:
1. Determine if there is too much background noise for a good test. Explain to the patient that they have indicated some quieter tones are more easily heard than louder tones. Request that the patient be more consistent.
2. Explain to the patient that the test will resume with the last tone.
3. Press the AUD button.
To CANCEL this test, press the SPEC button.

The ***not consistent*** error indicates the patient may be inattentive or there may be background noise


AUDIOMETER ERROR DETECTED:
False Response
To CONTINUE this test:
1. Explain to the patient that they pressed the button when a tone was not present. They might also have been too slow in pushing the button down.
Ask the patient to only press the button when they hear a tone, and to do it quickly.
2. Explain to the patient that the test will resume with the last tone.
3. Press the AUD button.
To CANCEL this test, press the SPEC button.

The ***false response*** error indicates the patient may be guessing

Figure 9
Additional error messages

When the ***Audiometer*** screen is displayed, the AFHCAN software is expecting to receive audiometry data. However, the Earscan module is able to perform any of its functions, so it is equally possible to initiate audiometry or one of the three tympanometry functions (normal

tympanometry, calibration, or fast tympanometry). The Earscan module communicates with the AFHCAN software, so the AFHCAN software knows which button was pushed and responds accordingly. When the ***Audiometer*** screen is displayed, pushing one of the tympanometry buttons on the Earscan module leads to one of the error messages shown in Figure 10.

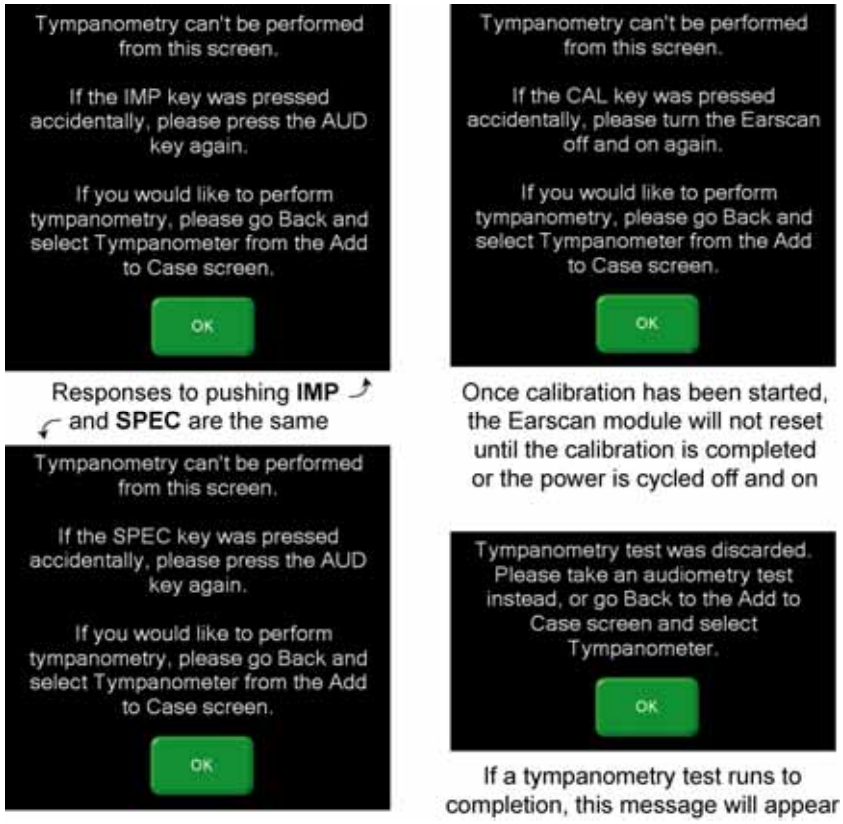

Tympanometry can't be performed from this screen.
If the IMP key was pressed accidentally, please press the AUD key again.
If you would like to perform tympanometry, please go Back and select Tympanometer from the Add to Case screen.
OK
Tympanometry can't be performed from this screen.
If the CAL key was pressed accidentally, please turn the Earscan off and on again.
If you would like to perform tympanometry, please go Back and select Tympanometer from the Add to Case screen.
OK
Responses to pushing IMP and SPEC are the same
Once calibration has been started, the Earscan module will not reset until the calibration is completed or the power is cycled off and on
Tympanometry can't be performed from this screen.
If the SPEC key was pressed accidentally, please press the AUD key again.
If you would like to perform tympanometry, please go Back and select Tympanometer from the Add to Case screen.
OK
Tympanometry test was discarded. Please take an audiometry test instead, or go Back to the Add to Case screen and select Tympanometer.
OK
If a tympanometry test runs to completion, this message will appear

Figure 10
Error messages when tympanometry functions are selected

1.2 Particulars of the AFHCAN Installation

The Earscan audiometer has been reprogrammed to work efficiently on an AFHCAN Cart. All but four of the buttons on the front panel of the Earscan module are covered. Most of the features associated with those buttons pertain to custom setups that are operationally complex and beyond the needs that the AFHCAN Cart is designed to address.

The **SPEC** button has been redefined. With regard to audiometry, the **SPEC** button can be used to cancel an audiometry test and reset the Earscan module when audiometry is in pause mode.

Section 2 – Operation

2.1 Basic Operating Procedures

2.1.1 Starting the Audiometer

Initiate audiometry as follows:

1. If necessary, turn on the Earscan audiometer by setting the On/Off power switch to the ***1*** position.
2. From the ***Add To Case*** screen, press the **Audiometer** button. The AFHCAN software will bring up the ***Audiometer*** screen on the monitor.

2.1.2 Performing an Audiometry Test

The following is the procedure for doing audiometry:

1. Have the patient remove any large earrings, glasses, hats, or other items that may interfere with headphone placement.
2. Seat the patient in a comfortable position facing away from the audiometer.
3. Brief the patient about the test as follows:
   - the goal is to measure the lowest volume of sound you can hear
   - you will hear tones at different volumes and different pitches (notes)
   - these tones will be presented in groups of three
   - press the response button once whenever you hear one or more of the tones in a group
   - it takes about 10 minutes to complete the test
4. Place the headphones on the patient's head with the red cable going to the patient's right ear and the blue cable going to the left.
5. If necessary, help the patient adjust the headphones for a good fit by sliding the ear pieces up or down.
6. When ready, press the **AUD** button on the Earscan module. The test will begin.
7. Listen for error tones generated by the Earscan module, and respond appropriately. (Instructions on how to respond to the different types of errors are given below).
8. If the test completes successfully, the Earscan module will generate a musical sequence of tones, and the results of the hearing test will be displayed on the ***Audiometer*** screen. At this point there are three options:
   a) press the **Save** button on the ***Audiometer*** screen to save the audiogram to the case (a green checkmark by the thumbnail marks the data to be saved)
   b) press the **Take Another** button on the ***Audiometer*** screen to take an additional audiogram

c) press the **Back** button to return to the ***Add To Case*** screen without saving data

9. On completion of testing, remove the headphones. If the audiometer (or tympanometer) will not be used for a while, you may turn the Earscan module off.

2.1.3 Pausing an Audiometry Test

It is possible to pause the audiometry test and resume from where the test left off. This may be useful if there is unexpected background noise or some other temporary distraction taking place. Proceed as follows:

1. While the test is underway, push the **AUD** button on the Earscan module. This pauses the test.
2. At this point there are two options:
   a) when ready, resume the test by pressing the **AUD** button again
   b) cancel the test and reset the Earscan module by pressing the **SPEC** button

2.2 Responding to Error Messages

The procedures for error recovery begin at the point where the user is notified of the error. There are three general types of error conditions:

- user response errors
- operator errors
- equipment problems

2.2.1 User Response Errors

User response errors are indicated in three ways:

- the Earscan module will generate an audible error alarm tone
- the LCD display on the Earscan module will identify the type of error
- the ***Audiometer*** screen will identify the type of error

2.2.1.1 "Button Down" Error

The *button down* error comes up when the user holds the response button down too long. When the error comes up, the audiometry test will enter pause mode. Proceed as follows:

1. Remove the headphones and remind the patient to push the response button only when he or she hears tones.
2. Place the headphones back on the patient's head, and make sure he or she is comfortable.
3. At this point there are two options:
   a) press the **AUD** button on the Earscan module to resume the test from where it left off
   b) press the **SPEC** button to cancel the test and reset the Earscan module

2.2.1.2 "False Response" Error

The *false response* error means the patient response fell outside the response window too many times. This may indicate the patient is trying to guess when to respond. This error puts the audiometry test in pause mode. Proceed as follows:

1. Remove the headphones and advise the patient that good information will be obtained if the patient listens carefully and pushes the response button only when he or she actually hears tones.
2. Place the headphones back on the patient's head, and make sure he or she is comfortable.
3. At this point there are two options:
   a) press the **AUD** button on the Earscan module to resume the test from where it left off
   b) press the **SPEC** button to cancel the test and reset the Earscan module

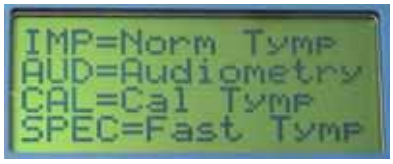
2.2.1.3 "Not Consistent" Error

The *not consistent* error comes up when the user correctly responds to tones at low volumes but fails to respond to tones at higher volumes. This may be due to background noise or inattention to the test. When the error comes up, the audiometry test will enter pause mode. Proceed as follows:

1. Remove the headphones and remind the patient to listen carefully and push the response button each time he or she hears the tones.
2. Try to remove any sources of background noise.
3. Place the headphones back on the patient's head, and make sure he or she is comfortable.
4. At this point there are two options:
   a) press the **AUD** button on the Earscan module to resume the test from where it left off
   b) press the **SPEC** button to cancel the test and reset the Earscan module

2.2.2 Operator Errors

Operator errors are only indicated on the ***Audiometer*** screen.



When the Earscan module is ready to begin testing, it will show the screen at the right in the LCD display. At this point, the Earscan module is ready to perform tympanometry as well as audiometry. However, when the ***Audiometer*** screen is displayed, pushing any button on the Earscan module besides the **AUD** button will result in an error message appearing in a pop-up window on the ***Audiometer*** screen.

2.2.2.1 Accidentally Pushing IMP or SPEC

To respond to the **IMP** or **SPEC** error message, proceed as follows:

1. Press **OK** on the pop-up window to clear the message from the ***Audiometer*** screen.

2. Press **AUD** on the Earscan module to reset the module (the LCD display will return to the screen shown above).

3. Press **AUD** again to begin the audiometry test.

2.2.2.2 Accidentally Pushing CAL

Once the Earscan module has been placed in calibration mode, it will remain in this mode until the calibration test has been completed, or the Earscan module has had its power cycled off then on.

The fastest way to respond to the **CAL** error message is to proceed as follows:

1. Press **OK** on the pop-up window to clear the message from the ***Audiometer*** screen.

2. Turn off power to the Earscan module by placing the Power On/Off switch in the **0** position, wait a moment, and turn power back on.

3. Press the **AUD** button on the Earscan module to begin the audiometry test.

Section 3 – Clinical Considerations

3.1 Guidelines for Clinical Success

Obtaining a good audiogram requires the following:

- little or no noise in the background
- the patient is attentive to the test
- the ear canals do not have an excessive accumulation of wax

3.2 Common Mistakes

Avoid the following:

- do not allow the patient to view the audiometer because the LCD display indicates when a tone is present
- do not inadvertently cue the patient
- make sure the headphones have been adjusted to fit comfortably and cover the ears

Section 4 – Routine Maintenance

4.1 Care and Cleaning

In general, the Earscan module and cables can be wiped down with a damp cloth.

4.2 Elementary Troubleshooting

The only user-level troubleshooting available on the Earscan audiometer are the basic things such as:

- verify that all plugs are fully inserted into the proper connection jacks
- ensure that power is available to the unit and the power cord is plugged in at both ends
- check to see that the power switch is on

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